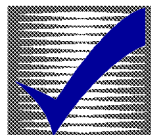




HOW-TO BOOKLET #3001

FUSE FAILURES



TOOL & MATERIAL CHECKLIST

- Replacement Fuses
- Fuse Puller
- Continuity Tester
- Board, 1X12X2-foot

Read This Entire How-To Booklet for Specific Tools and Materials Not Noted in the Basics Listed Above.

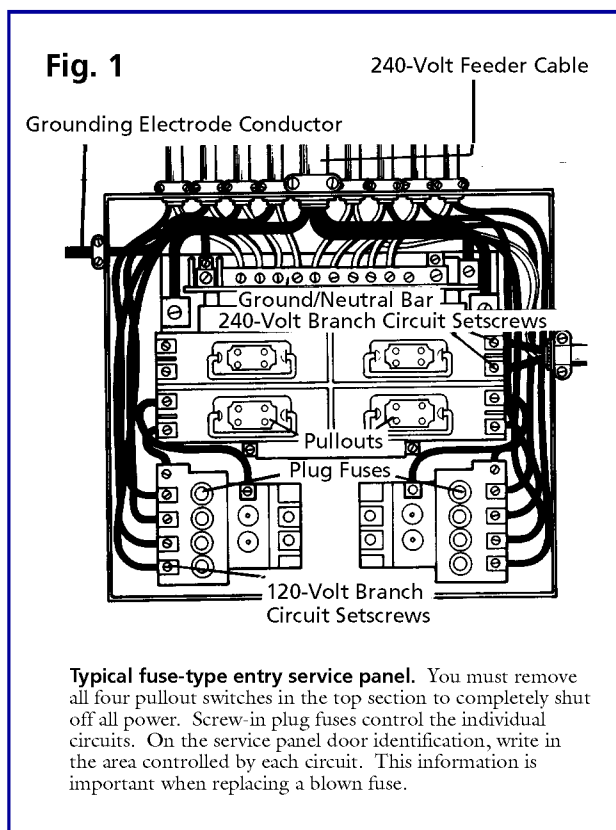
The electrical protective system in your home acts as a safety device. It cuts off the electricity flowing through wiring (circuits) when wiring becomes overloaded or there is a short in the circuit. There are two protective systems: plug or cartridge fuses and circuit breakers.

Both types of protective safety devices service the same purpose — they shut off power when a circuit carries more current than it should. Fuses destroy themselves (blow) and must be replaced. Circuit breakers function as switches that automatically trip open when current exceeds the circuit breaker rating. They can be reset manually by pushing the handle to the OFF position, then to the ON position.

In this booklet we'll cover household fuse systems, while circuit breakers are discussed in How-To Booklet #3002.

SAFETY COMES FIRST

Working with electricity is not hazardous as long as you obey strict safety rules. Always shut off or disconnect power before handling wires. If you are working on the electrical service panel, do not stand on a damp floor. Protect yourself by wearing rubber gloves and rubbers, and stand on a rubber mat or a piece of dry wood. Above all, if you are in any doubt about how to do any particular job, call in a licensed electrician.



FUSE BOX

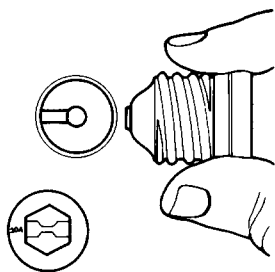
The main service panel, usually called the fuse box in a household fuse system, is where all electrical circuits start and end. That is, electric power passes through a meter, then enters the house and is distributed by the main service panel.

Ordinarily, main and branch fuses are located in a metal fuse box that is equipped with a lever-type disconnect switch or a fusible pullout switch (Fig. 1). The branch fuses have screw-in sockets.

Before working on your electrical system, shut off all power and make sure that a good continuous connection exists from the neutral or the service panel box to a ground rod driven into the earth or to a metal water pipe system. Also, make sure that the neutral is connected to the service panel box with a wire or bonding screw. If the main pullout switch(es) are in a separate box, these connections should be in that box instead. No ground connections should be made to white neutral wires anywhere else in your system, and no other neutral bar should be connected to the box in which it is mounted.

Some appliance circuits use fused receptacles. They can save you a trip to the main service panel. If you overload the circuit and blow the fuse, only this receptacle is out of order, and the bad fuse is at your fingertips.

Fig. 2



The standard plug fuse screws into socket in the fuse box. Match fuse amps to the circuit.

TYPES OF FUSES

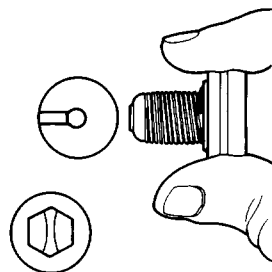
There are just two styles of fuses: plug and cartridge. But, within these two styles there are several variations.

Plug Fuses. This style of fuse has a screw base that screws into a socket in the fuse box in the same way that a light bulb screws into a lamp socket. There are three types of plug fuses: standard, type S, time delay, and circuit breaker.

Standard fuses (Fig. 2) look similar to the bases of light bulbs. A metal strip runs through the center at the top of the fuse. You can see it through a tiny window. If the window looks black or discolored, the fuse usually is defective.

Type S fuses (Fig. 3) are similar to standard fuses, except for one notable difference. A type S fuse consists of two parts, the fuse itself and a socket adapter. The adapter screws into and becomes part of the socket in the fuse box. Do not remove the adapter unless it shows signs of being defective, such as cracking or discoloration. The other part, the fuse itself, screws into the adapter. Threads of a particular size (ampere) type S fuse are designed to be screwed into threads of the same size adapter and no other. For example, a 15-amp type S fuse fits only a 15-amp type S fuse adapter; a 20-amp type S fuse cannot be substituted for a 15-amp type fuse. A type S fuse assembly, therefore, prevents someone from replacing one size fuse with an incorrect size, either by accident or on purpose.

Fig. 3

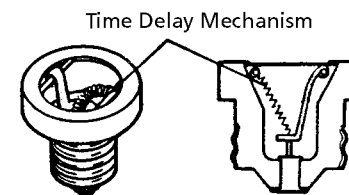


Type S fuses have mismatched bases/sockets for safety.

Time delay fuse (Fig. 4) allows temporary circuit overloading. In homes, time delay fuses are used in circuits that accommodate heavy appliances, such as air conditioners, that cause a temporary surge in power when they are turned on. The time delay fuse is made with a spring-loaded metal strip (link) that attaches to a plug of solder. As the power surge takes place, the fuse doesn't blow immediately, as would happen with a standard type or type S fuse. Instead, the solder begins to melt. It must melt through completely before the fuse will blow. The delay allows for a limited period of power surge. However, if the overload continues beyond a certain point, the solder melts completely and the spring pulls the link free. The fuse then blows and interrupts the circuit.

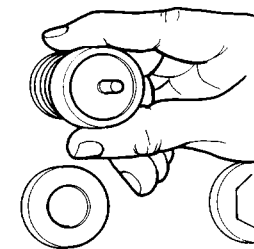
Circuit-breaker fuses (Fig. 5) have a push button that pops out from the center of the face. When the fuse blows, you simply push in on the push button to reset the fuse. It works like a toggle-type circuit breaker.

Fig. 4



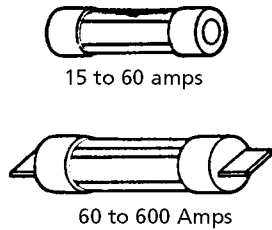
Time delay fuses allow a temporary overload before blowing. Designed for appliances that draw a heavy surge of power when they start up.

Fig. 5



Circuit breaker fuses have push buttons to reactivate them.

Fig. 6



Two types of cartridge fuses:
(top) Rounded end and (bottom) knife-blade shaped end

Cartridge Fuses. Two types of cartridge fuses (Fig. 6) are used in homes. One type has round ends and a capacity of 15 to 60 amperes. It is used to protect a circuit on which there is a major electricity-drawing appliance, such as a kitchen range, clothes dryer, or air conditioner. Each circuit servicing a large appliance may be protected by a cartridge fuse. The other type of cartridge fuse is used to protect the main power circuits. This fuse has knife-blade contacts on each end and is rated at a capacity of 60 to 600 amperes.

It is rare for cartridge fuses to fail, but if there is no other explanation for an inoperative appliance or for a power failure, it may be due to the particular cartridge fuse. The main reasons for cartridge fuse failure are the same as the reasons for plug fuse failure; that is, overload on the circuit or a short circuit. A cartridge fuse also may fail because of old age.

FUSE SIZES

As already noted, all fuses are rated in amperes. They will be stamped with numbers or ratings from 15 to 60 or 60 to 600 amps. As a rule of thumb, a No. 14 wire (regular lamp circuit) takes a 15-amp fuse (1750-watt capacity); a No. 12 wire circuit takes a 20-amp fuse (2300-watt capacity); a No. 10 wire takes a 30-amp fuse (3500-watt capacity). The chart at right gives the recommended (minimum) fuse amperage size for typical household circuits.

WARNING:

Do not change fuse size in a circuit. If your system has been plagued by burned fuses because of overloaded circuits, do not solve the problem by substituting a larger fuse for a smaller one. Such action seriously jeopardizes the safety of your home. The wire in a 15-amp circuit has more resistance than wire in a 20-amp circuit. When a wire resists current, energy is dissipated in the form of heat, which in turn can cause a fire. The resistance level of the metal strip in a fuse should match the resistance level of its wire. Normally the wire and the fuse strip don't heat up because they carry no more current than they can handle. If, however, you replace a 15-amp fuse with a 20-amp fuse, your system is in trouble. Once the current goes over 15 amps, the wire begins to heat. However, the 20-amp fuse, which responds only to an amperage level of over 20 amps, does not respond at all. Because of the difference between the fuse and the wire sizes, there is too much current in the circuit and you have created the potential for an electrical fire.

It is wise to keep spare fuses handy near the fuse box.

Troubleshooting a Circuit. When a fuse blows and the power goes off, the most likely cause is usually an overloaded circuit. An overloaded circuit is when too many appliances or lights are plugged into a circuit. When overload occurs, the small wire in the fuse breaks without heating excessively. The window on the fuse should be clean so you can see the broken wire.

Typical Circuit Application	Fuse Amperage
Attic fan (up to 1/2HP 120) V	15
Branch circuit 120V	15
Doorbell transformer 120V	15
Motors (single phase)120V up to 1/2 HP	15
Range hood 120V	15
Sump pump 120V	15

*Air conditioner 120V up to 11,000 BTU	20
240V up to 23,00 BTU	20
Kitchen branch circuit 120V	20
Dishwasher 120V	20
Electric heat 120V up 1650 watt	20
*Electric range 240V up to 5kW	20
Motors (single phase) 120V 1/2 to 1 HP	20

*Air conditioner 240V up to 36,000 BTU	30
*Clothes dryer 240 V	30
Electric range 240 V 5kW to 8kW	30
Hot water heater 240V up to 6 kW	30

Well pump (up to 1/2 HP) 120V up to 200 feet	30
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*Electric Range 240V 8kW to 10 kW	40
Well pump (up to 1/2 HP) 120v 201 to 300 ft	40

*Electric range 240 V 10 kW to 20 kW	50
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* Follow directions on appliance nameplate for branch circuit amperage if given.

Fuses that continually blow usually can be traced to an overloaded circuit. So, before you replace a blown fuse, check along the circuit for the overload: too many lights? too many appliances? Correct this situation and replace the fuse.

The second cause of fuse problems is a short circuit, which is one bare electrical wire touching another bare wire or piece of metal. The rate of flow of the electric current is excessive when a short circuit occurs. The fuse wire vaporizes, spraying and discoloring the fuse window.

To check for a short circuit:

- 1 Turn off the power (main fuse) at the service panel.
- 2 Unplug all lamps, overhead fixture light bulbs, and any appliances on the failed circuit.
- 3 Check the wire plugs. If a plug is cracked, has melted from heat, or has broken prongs, do not reconnect the plug until it has been either repaired or replaced. Replacements are cheap.
- 4 If you spot a worn or frayed wire on a lamp or appliance cord, replace or repair it.
- 5 Replace the fuse on the circuit with ALL appliances, lamps and other electrical devices disconnected.
- 6 Wait one minute. If the fuse blows again, the problem is the house wiring — usually behind a wall. Call a professional electrician, unless you can spot and repair the damage.
- 7 If the new fuse doesn't blow, the wiring is okay.
- 8 Remove the fuse.
- 9 Reconnect one of the disconnected items. Replace the fuse. If the fuse doesn't blow, this lamp or appliance is not the problem. Continue plugging in all items on the circuit.
- 10 Always remove the fuse and plug in the device. Then replace the fuse. The device with the short circuit will blow the fuse. Repair device before you replace the fuse.

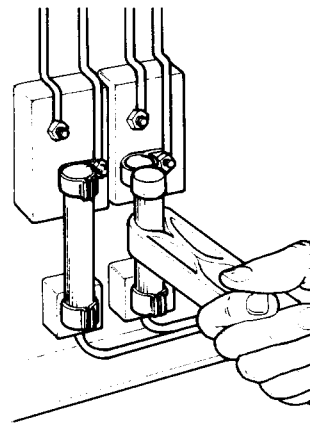
REPLACING BLOWN PLUG FUSES

The first step is to turn off all lights and appliances on the circuit controlled by the fuse. Then turn off the main power. In newer houses, the main power is controlled by two boxes that are equipped with cartridge fuses. To shut off the main power so you can safely remove the blown fuse, grasp the handles of the cartridge boxes, one at a time, and pull the boxes from place. In older houses, the main power is controlled by a lever-type switch on the side of the fuse box. To cut the power, pull this switch downward.

Actual fuse replacement is simple, but use care when working at the panel.

- 1 Select a fuse rated for the same amperage as the one you are replacing.
- 2 Turn the blown fuse counterclockwise to remove it from the fuse box.
- 3 Install the new fuse by screwing clockwise into the socket.
- 4 Replace the main fuse boxes or turn the main power on.

Fig. 7



Remove the fuse from the spring clips.

REPLACING FAULTY CARTRIDGE FUSES

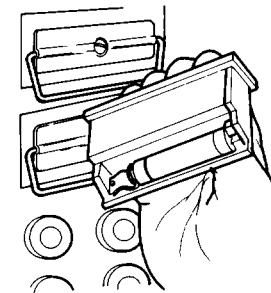
To determine if a cartridge fuse has failed, proceed as follows:

- 1 Turn off the main power and open the service panel of the fuse box.
- 2 Using a fuse puller, grasp the middle of the fuse (Fig. 7) and pull it out of the spring clips that hold it in place. If the fuse has knife blade ends, don't bend them.
- 3 Some cartridge fuses are mounted in a compartment-type housing (Fig. 8). To remove the fuses, grasp the wire-loop handle and pull the compartment straight out of the panel.
- 4 To test the fuse, touch one probe of a continuity tester to one end of the fuse and the other probe to the other end. If the tester lights, the fuse is okay. If the tester does not light, replace the fuse.

CAUTION: Never test a fuse while it is in the service panel. Always remove it from the service panel.

- 5 To install a cartridge fuse, push it into the spring clips by hand. If a new fuse fails, the problem is in the circuit wiring or there is a short circuit in an appliance.

Fig. 8



Cartridge fuses are found in most main panel pullout boxes.